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State of the Grid: The Four Pillars Needed for a Successful Clean Energy Transition

New England Council

Gordon van Welie

PRESIDENT & CEO

ISO New England's *Mission and Vision*

Mission: *What we do*

Through collaboration and innovation,
ISO New England plans the transmission system, administers the region's wholesale markets, and operates the power system to ensure reliable and competitively priced wholesale electricity

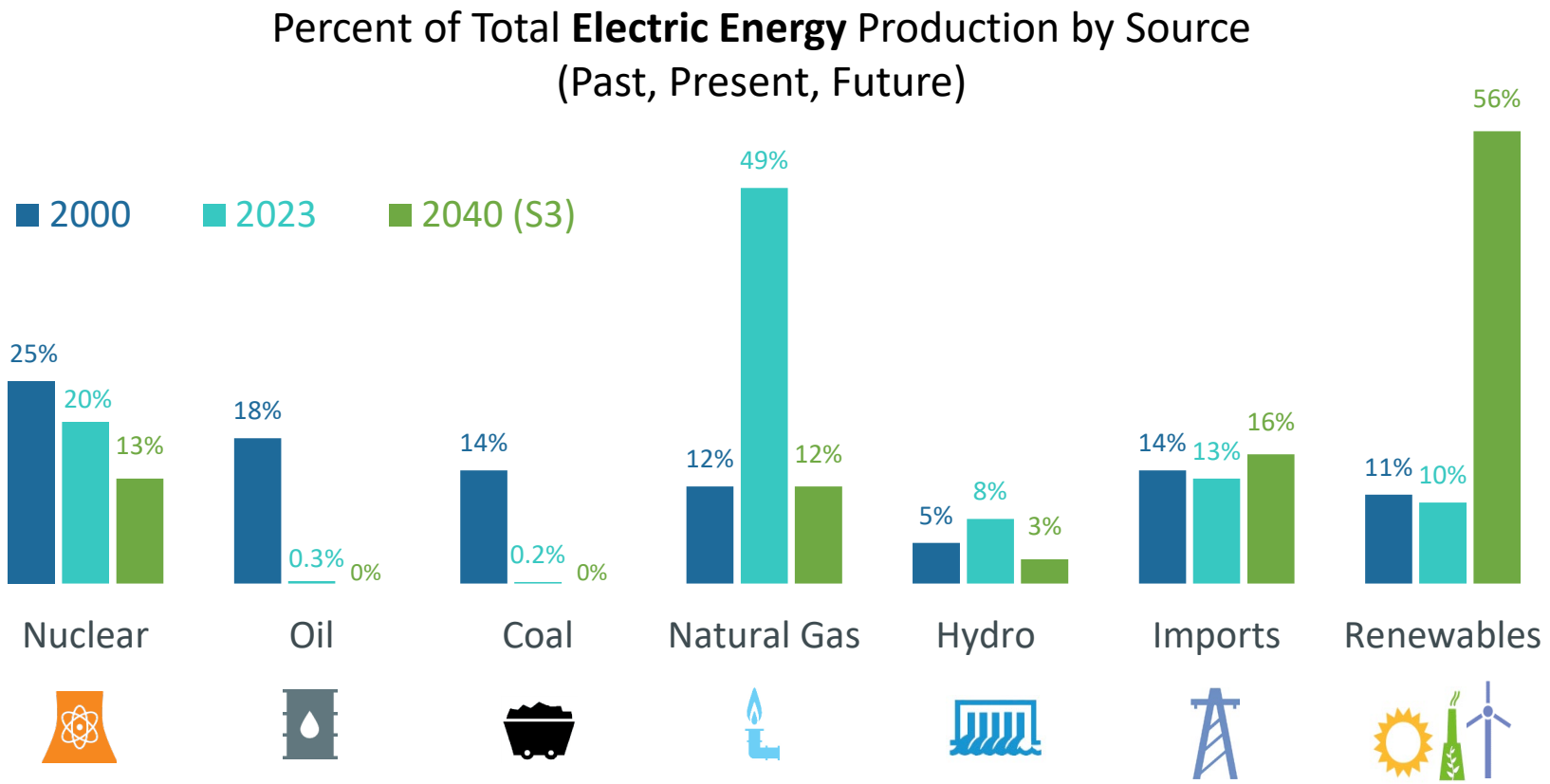
Vision: *Where we're going*

To harness the power of competition and advanced technologies to reliably plan and operate the grid as the region transitions to clean energy

*The ISO's **Vision** for the future represents our long-term intent and guides the formulation of our Strategic Goals*

Dramatic Changes in the Energy Mix

New England made a major shift from coal and oil to natural gas over the past two decades, and is shifting to renewable energy in the coming decades



Source: ISO New England Net Energy and Peak Load by Source; data for 2023 is preliminary and subject to resettlement; data for 2040 is based on Scenario 3 of the ISO New England 2021 Economic Study: Future Grid Reliability Study Phase 1.

Renewables include landfill gas, biomass, other biomass gas, wind, grid-scale solar, behind-the-meter solar, municipal solid waste, and miscellaneous fuels.

There Are Four Pillars Necessary to Support a Successful Clean Energy Transition

PILLAR ONE

Clean Energy

Significant amounts of clean energy to power the economy with a greener grid

PILLAR TWO

Balancing Resources

Resources that can supply electricity, reduce demand, or provide other services to maintain power system equilibrium

PILLAR THREE

Energy Adequacy

A dependable energy supply chain and/or a robust energy reserve to manage through extended periods of severe weather or energy supply constraints

PILLAR FOUR

Robust Transmission

To integrate renewable resources and move clean energy to consumers across New England

Pillar One: Significant Amounts of Clean Energy

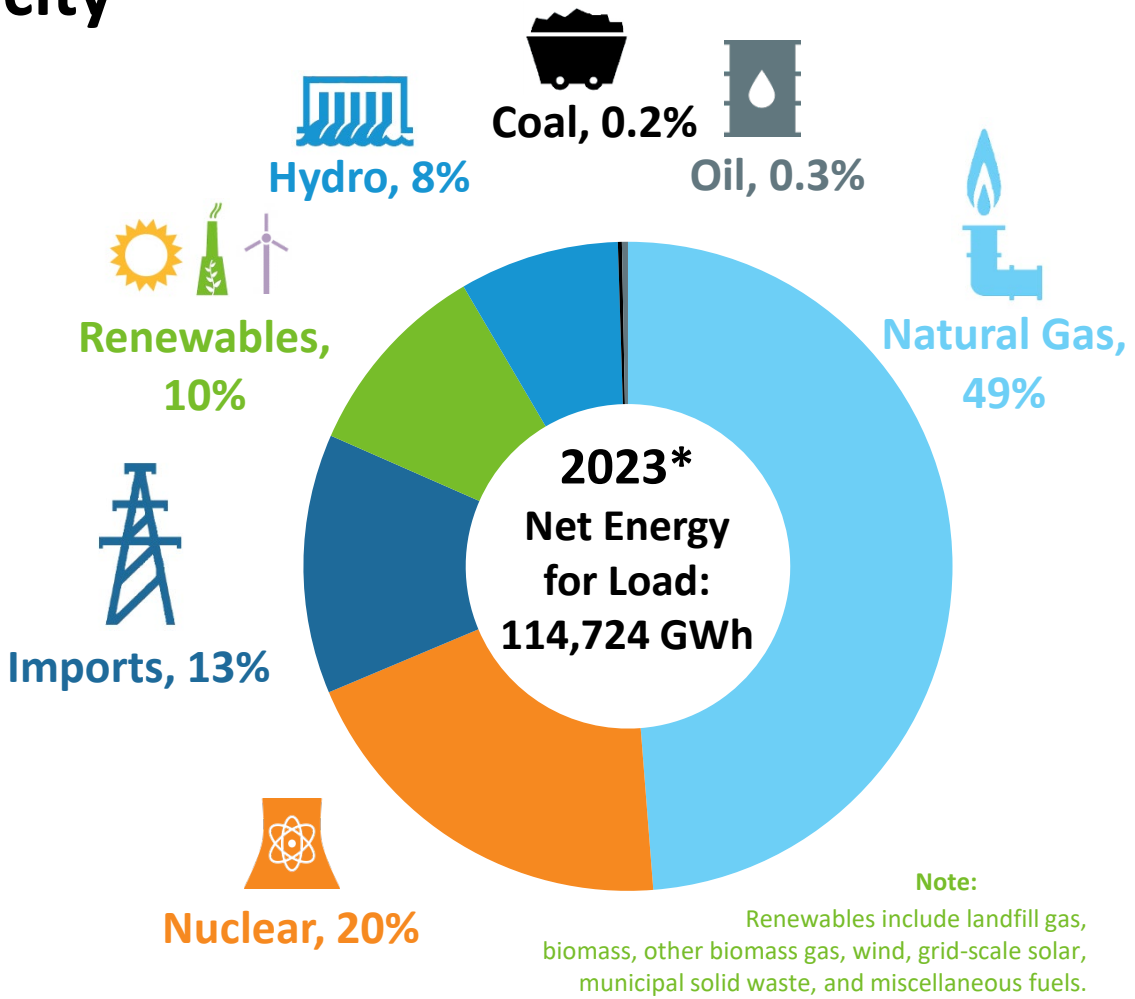
- The ISO expects to see **dramatic changes to the region's power system** in the decades ahead. State goals and requirements represent the power system's largest catalyst for change
- Over the next 15 years, the region needs to add almost **twice as much new generation** as it added in the last 25 years
- By the early 2030s, the annual energy needed to heat buildings and charge electric vehicles is expected **to grow to about 20 times** the forecast for 2024

PILLAR ONE STATUS:
YELLOW TRENDING GREEN

In the coming years, construction of unprecedented amounts of clean energy resources will be needed to meet state decarbonization goals while serving significantly increased demand.

Lower-Emitting Sources of Energy Supply Most of New England's Electricity

- In 2023, most of the region's energy needs were met by natural gas, nuclear, imported electricity (mostly hydropower from Eastern Canada), renewables, and other low- or non-carbon-emitting resources
- Region is transitioning away from older coal and oil resources

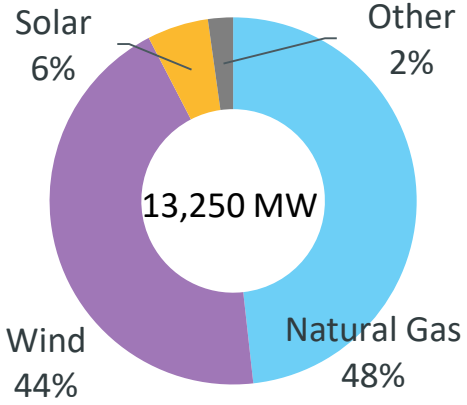


*Data is subject to adjustment. Source: 2023 Net Energy and Peak Load by Source
https://www.iso-ne.com/isoexpress/web/reports/load-and-demand/-/tree/net-ener-peak-load

The ISO Generator Interconnection Queue Provides a Snapshot of Resource Proposals

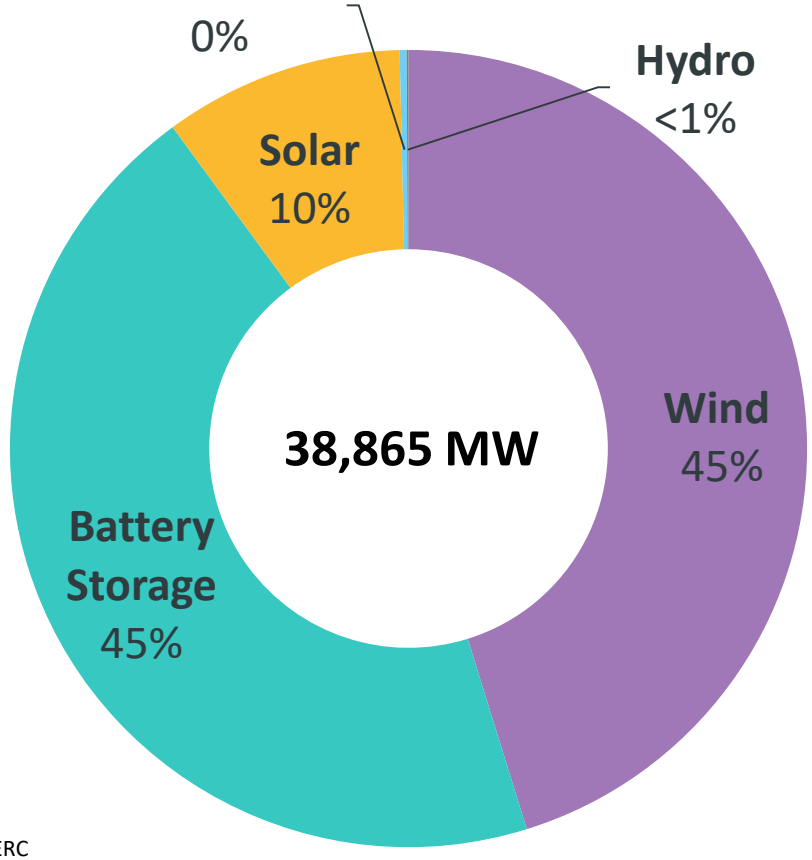
Dramatic shift in proposed resources from natural gas to battery storage and renewables

Then



June 2017

Now



March 2024

Offshore Wind

CT	3,600 MW
MA	10,741 MW
RI	704 MW

Onshore Wind

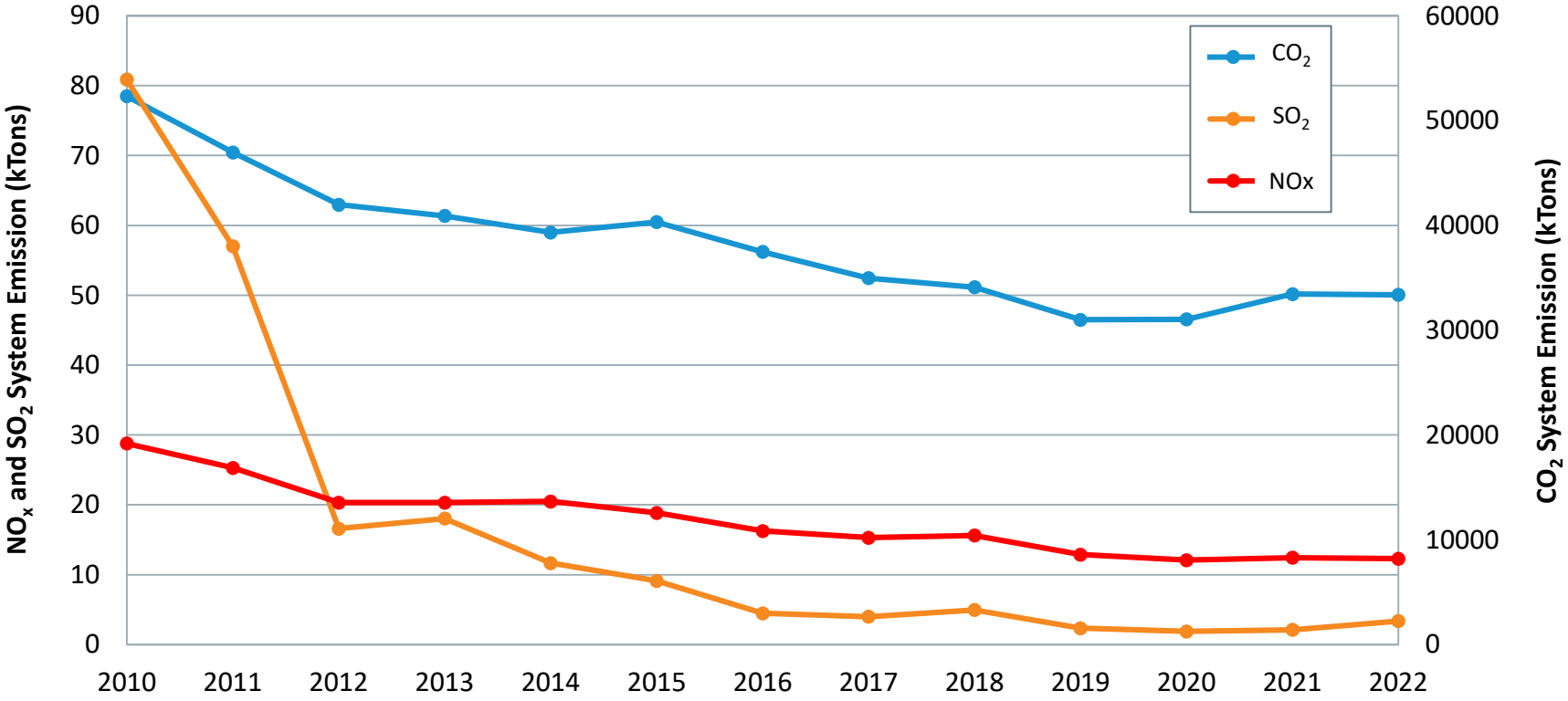
ME	2,522 MW

Source: ISO Generator Interconnection Queue, FERC Jurisdictional Proposals; Nameplate Capacity Ratings.

Major Emissions Reductions

Emissions from regional generators have fallen significantly since 2001

Annual New England System Generator Emissions, 2010-2022 (Thousand Short Tons)



Carbon Dioxide (CO_2) ↓36% **Nitrogen Oxide (NOx) ↓57%** **Sulfur Dioxide (SO_2) ↓96%**

Source: ISO New England, *New England Electric Generators Air Emissions Report*

Pillar Two: Balancing Resources

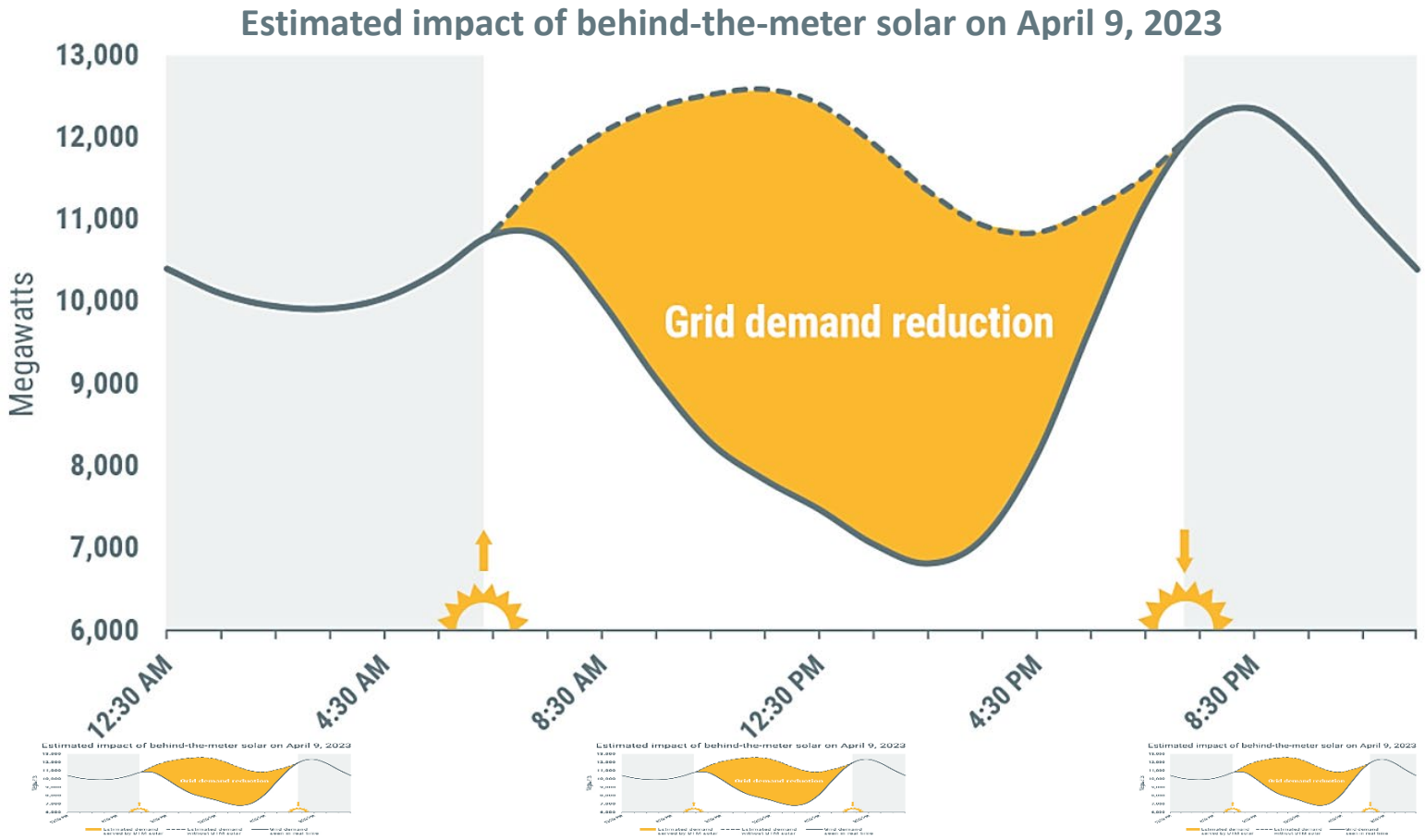
- The ISO's research consistently finds that **dispatchable resources**—which can include generation, storage, and demand response—will play a vital role throughout the clean energy transition by filling gaps between supply and demand
  - Today, natural gas plants, pumped hydro, and demand response afford the grid much of its needed flexibility. In the future, clean alternative fuels and battery storage could bolster this role
- **Energy storage** is a key part of our grid's past, present, and future. Our research has found strong seasonal patterns for battery charging cycles in the future

PILLAR TWO STATUS:
YELLOW TRENDING GREEN

Dispatchable generators, energy storage, demand response, and a range of services will be crucial to ensure equilibrium as intermittent resources see swings in energy production.

Strong Growth in Solar PV Forecast, Driving Changes in Grid Operation

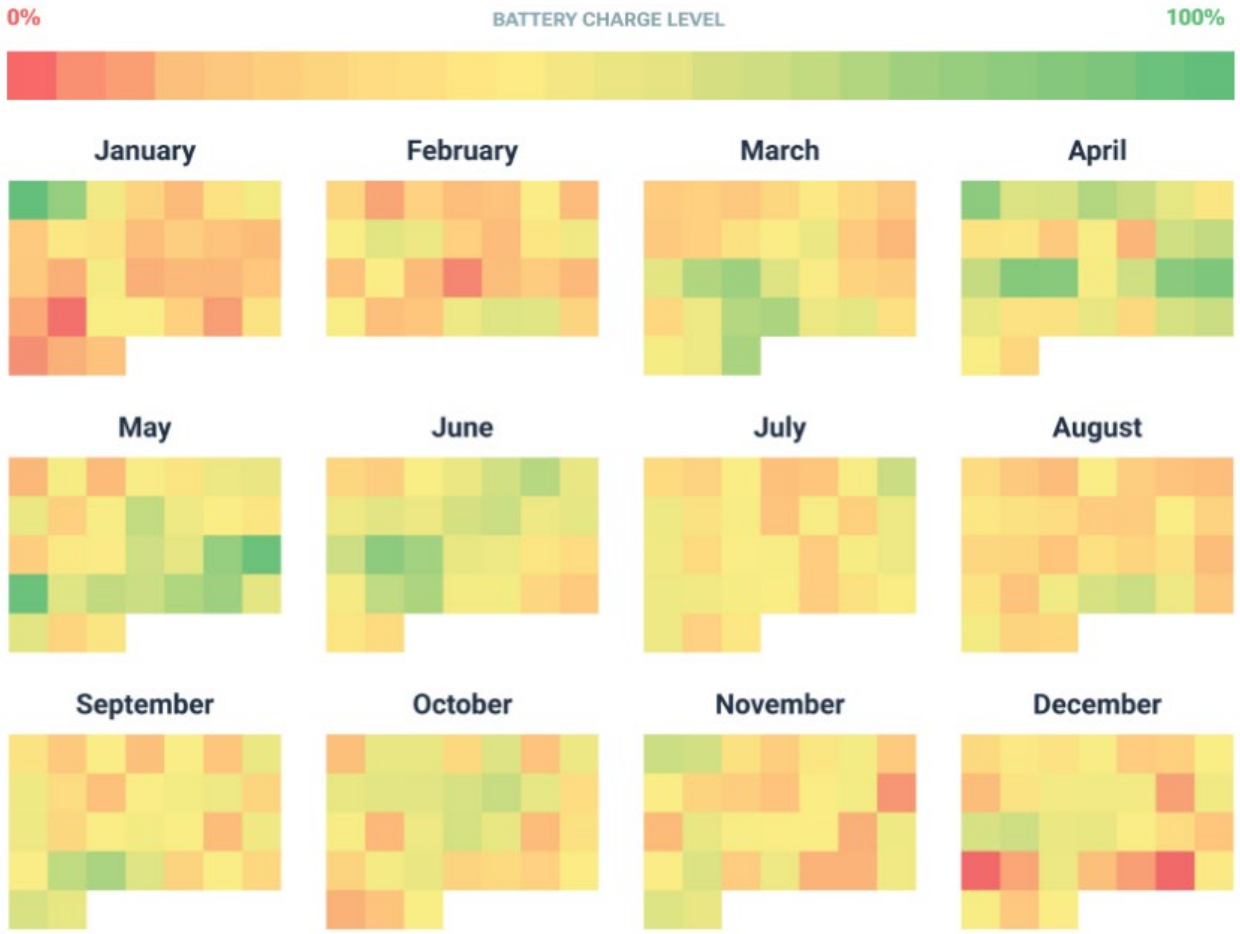
Almost 12 GW of Solar Anticipated by 2032



Source: ISO Newswire Article from February 28, 2024, 'Duck curve' days becoming more frequent as solar power spreads – ISO Newswire

Batteries Could See Charging Challenges in the Future Power System

- Modeling in the **Future Grid Reliability Study** found that, under some scenarios in a potential 2040 power system, the battery fleet may be depleted quickly and then struggle to recharge during the winter months.



Source: ISO 2024 Regional Electricity Outlook, Batteries Could See Charging Challenges in the Future Power System

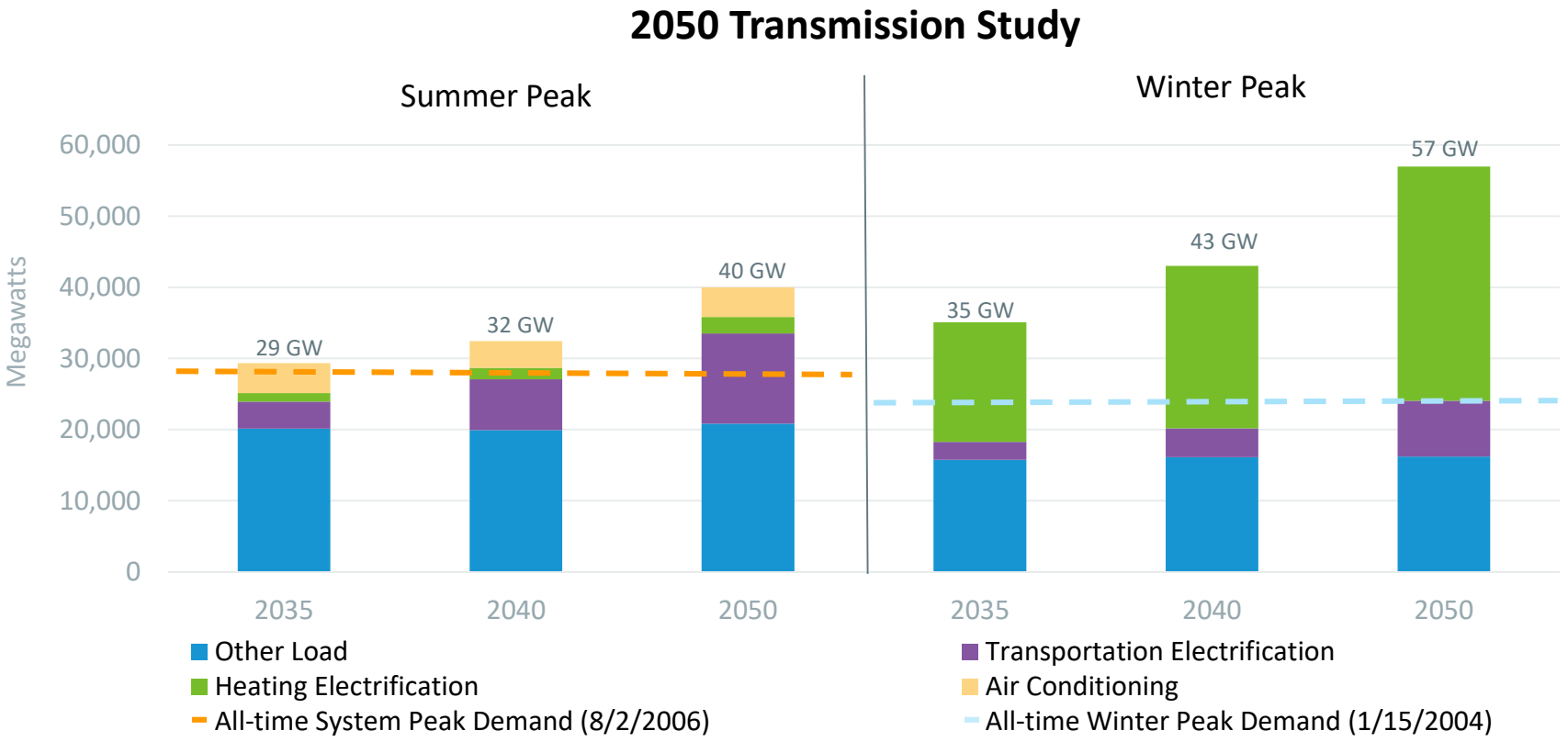
Pillar Three: Energy Adequacy

- The future grid faces energy adequacy challenges on two fronts:
  - **electrification** of the transportation and heating sectors will drive demand higher
  - **extreme weather** caused by climate change will increasingly affect the productivity of energy resources
- Over the last three decades, New England's peak electricity use has always been in the summer. But heating electrification is expected to turn the regional grid back into a **winter-peaking system** sometime in the mid-2030s
- In the near term, natural gas will remain the region's leading fuel source for electricity generation. But generators' **access to gas is limited in winter**, when more of that resource is dedicated to heating homes and businesses

PILLAR THREE STATUS: YELLOW TRENDING GREEN

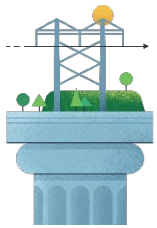
Risks to energy adequacy could increase if expected renewable resources don't materialize, needed transmission isn't built, or fuel supply chains are disrupted.

New England System Peak Grows Substantially and Shifts to Winter-Peaking



Source: ISO New England 2050 Study Draft Report. The future scenarios in the 2050 Study were based on the All Options Pathway in Massachusetts' Deep Decarbonization Roadmap report, published in December 2020.

Pillar Four: Robust Transmission



- In the next two decades and beyond, the **transmission system must become significantly more robust** if it is to continue meeting the region's changing needs
  - **demand will grow dramatically** as we become more reliant on electricity for heating and transportation
  - **sources of electricity will become greater** in number and **more geographically dispersed** as new clean energy resources come online
- Developers are proposing transmission upgrades that would deliver over 14,000 megawatts of clean energy from remote areas to the places in New England where it's needed most
  - Even so, the ISO projects that, by 2050, more than **half of the transmission system could face thermal overloads** during times of peak demand

PILLAR FOUR STATUS: YELLOW

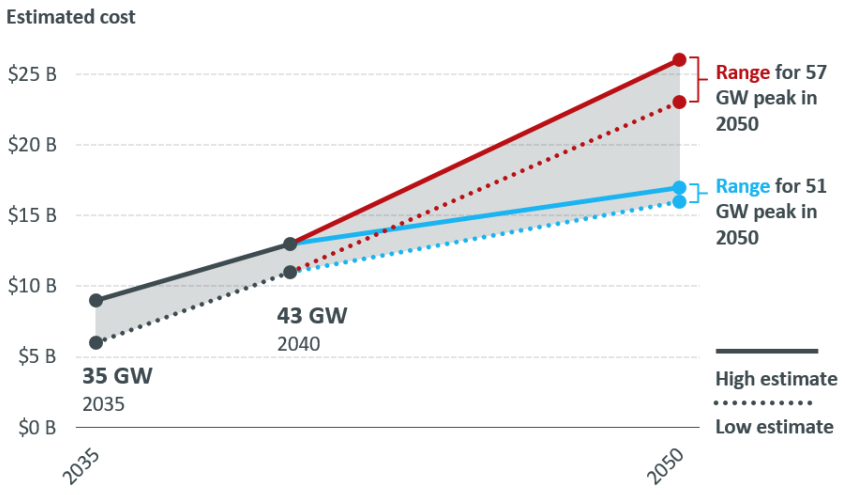
Significant investment in new and existing infrastructure will be critical to enabling the clean energy transition.

We Are Conducting Longer-Term Transmission Studies to Support State Policies

- State-Requested Process to Identify Transmission Concepts
  - Analyzes future scenarios identified by the New England States Committee on Electricity (NESCOE), based on one or more states' or localities' government requirements, mandates, or policies
  - Extends beyond the 10-year planning horizon
  - Identifies high-level transmission concepts and, if requested, cost estimates
  - ISO-NE's first Longer-Term Transmission Study (LTSS), the "2050 Transmission Study," was released in early 2024
- Process to develop transmission projects identified in LTTSs is under development
  - Would include a cost allocation mechanism for the transmission improvements

Transmission Cost for Serving Winter Peak Load

- The 2050 Transmission Study found that a 6 GW (~10%) reduction in winter peak could save $8 billion (~35-45%) in costs of addressing overloads
- The costs for addressing voltage/stability concerns and distribution system expansion were not included in the 2050 Transmission Study, and will also be driven by load growth



Source: 2050 Transmission Study, Figure 2-1

LOOKING AHEAD

New England Must Balance Multiple Objectives

Robust Wholesale Markets to Ensure Reliability

- The region's wholesale electricity markets are working as designed to maintain **reliability** of the region's bulk electric system while selecting the **lowest-priced** resources
- But, there is not an adequate regional mechanism to sufficiently value **clean energy attributes** or price carbon – which are public policy decisions

Affordable Decarbonization of the Regional Energy System

- Individual New England States have adopted policies to promote **renewable energy** and **decarbonization** of the region's power grid and economy
- **Existing carbon-free energy resources** are an important part of achieving these policies

***The Consequence**: Greater dependency on the capacity market for all resources, and a need for supplementary, out-of-market revenues for carbon-free resources that are uneconomic in the wholesale market*

We Are Developing Responsive Market Designs to Accommodate the Changing Resource Mix

Capacity Market Reforms

- Alt. Commitment Horizons
  - Replace the Forward Capacity Auction with a **prompt** auction (same as year of need) and make capacity a **seasonal** product
- Resource Capacity Accreditation
  - Implement new methodologies to **accredit** resources' capacity contributions to regional resource adequacy

Ancillary Services and Energy Adequacy Improvements

- Day-Ahead Ancillary Services
  - Procure and transparently price ancillary service capabilities for the next day's operating plan
- Flexible Response Services
  - Evaluate additional ancillary services for **ramping** and **longer-duration** reserves
- Regional Energy Threshold Metric
  - Establish a new Regional Energy Shortfall Threshold ("REST") metric to complement existing loss-of-load resource adequacy standard

Net Carbon Pricing Would Directly Price Carbon Emissions

Would drive the resource mix toward greater amounts of clean energy by harnessing the power of competitive wholesale markets

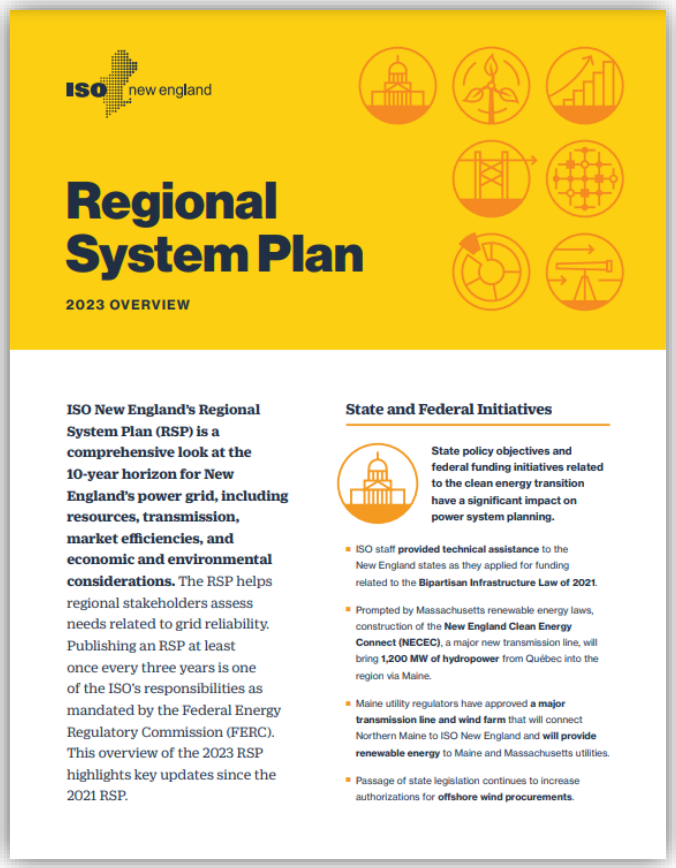
- **An efficient, market-based solution**
  - Compensates new and existing clean energy resources for their carbon-free energy
  - Provides powerful incentives to existing resources to reduce carbon emissions

- **Mitigates wholesale price effects**
  - Requires carbon-emitting resources to account for the cost of carbon emissions in their offer prices
  - "Net" means returning some revenue from higher energy market prices to load, and the balance to clean and low-emitting resources
  - Reduces dependency on a capacity market for all resources, and/or long term PPAs (for carbon-free resources that are uneconomic in the wholesale market)

Key Takeaways

- New England's electric power system is changing rapidly
- Economic and environmental factors are resulting in generator retirements, while state policies are driving investments in clean and renewable energy
- Retiring and emerging resources exhibit very different characteristics
- The ISO is developing responsive market designs to accommodate the changing resource mix
  - Resource Capacity Accreditation in the Forward Capacity Market
  - Day-Ahead Ancillary Services Initiative
  - Evolving capacity market timeframes
- ISO-NE is focused on developing solutions to today's grid challenges

New Reports on the Transformation of Our Region's Power Grid



ISO new england

Regional System Plan

2023 OVERVIEW

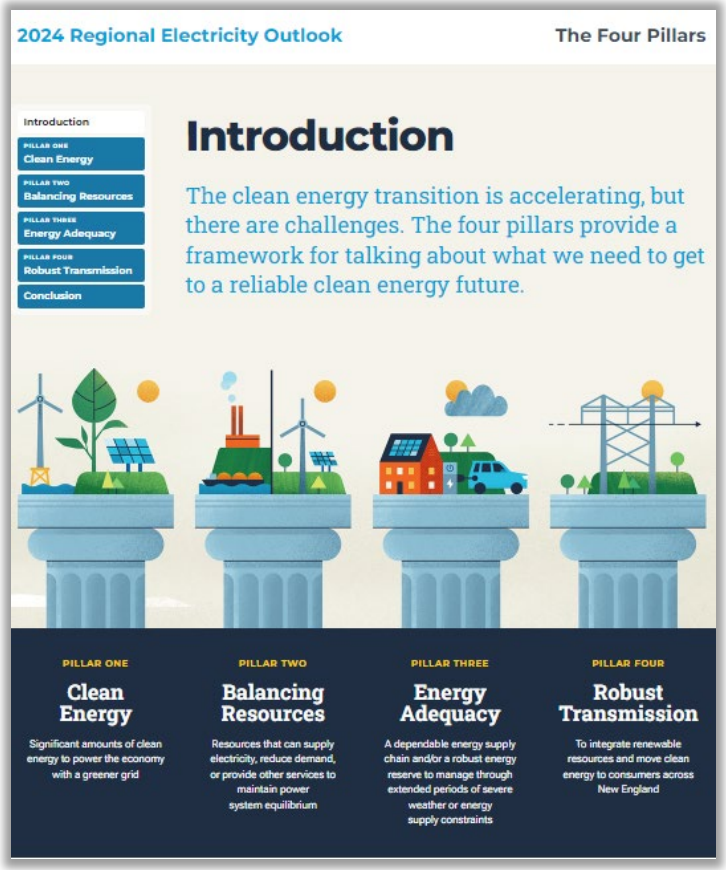
ISO New England's Regional System Plan (RSP) is a comprehensive look at the 10-year horizon for New England's power grid, including resources, transmission, market efficiencies, and economic and environmental considerations. The RSP helps regional stakeholders assess needs related to grid reliability. Publishing an RSP at least once every three years is one of the ISO's responsibilities as mandated by the Federal Energy Regulatory Commission (FERC). This overview of the 2023 RSP highlights key updates since the 2021 RSP.

State and Federal Initiatives

State policy objectives and federal funding initiatives related to the clean energy transition have a significant impact on power system planning.

- ISO staff **provided technical assistance** to the New England states as they applied for funding related to the **Bipartisan Infrastructure Law of 2021**.
- Prompted by Massachusetts renewable energy laws, construction of the **New England Clean Energy Connect (NECEC)**, a major new transmission line, will bring **1,200 MW of hydropower** from Québec into the region via Maine.
- Maine utility regulators have approved **a major transmission line and wind farm** that will connect Northern Maine to ISO New England and **will provide renewable energy** to Maine and Massachusetts utilities.
- Passage of state legislation continues to increase authorizations for **offshore wind procurements**.

[Regional System Plan 2023 Summary]



2024 Regional Electricity Outlook — The Four Pillars

Introduction
PILLAR ONE Clean Energy
PILLAR TWO Balancing Resources
PILLAR THREE Energy Adequacy
PILLAR FOUR Robust Transmission
Conclusion

Introduction

The clean energy transition is accelerating, but there are challenges. The four pillars provide a framework for talking about what we need to get to a reliable clean energy future.

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[2024 Regional Electricity Outlook]

Questions